



## **CONSTRUCTIBILITY REVIEW TO INSTALL A NEW N-192 115 KV TRANSMISSION LINE ON THE MBTA RIGHT-OF-WAY IN BEVERLY, MA**

### **INTRODUCTION**

ECE and National Grid transmission engineering have been asked to review the constructability of installing the new N-192 115 kV transmission line, either underground or overhead, within the main and Rockport branches of the MBTA's Newburyport/Rockport Line railroad right-of-way (ROW) as part of the Beverly Regional Transmission Reliability Project. The existing N-192 underground cable is installed in this ROW between NEP's Beverly #12 substation and a location in proximity to NEP's East Beverly Substation. *To maintain the reliability of the transmission system serving Cape Ann, it is critical that the existing N-192 line remain in service until the new N-192 line is complete.*

In order to assess the feasibility of installing the new 115 kV transmission line within the existing MBTA corridor, ECE and National Grid first performed a field reconnaissance to observe current conditions along the tracks where possible without entering MBTA property and a desktop analysis using available data including railroad property maps and National Grid transmission drawings. Subsequently, ECE and National Grid met with representatives of the MBTA in the field to review MBTA requirements for work within active ROWs, and to discuss the specific challenges associated with the potential use of this ROW.

The following sections describe the current configuration of the Newburyport-Rockport ROW, provide an overview of the MBTA's requirements, and assess the feasibility of constructing the new line either underground or overhead within the ROW.

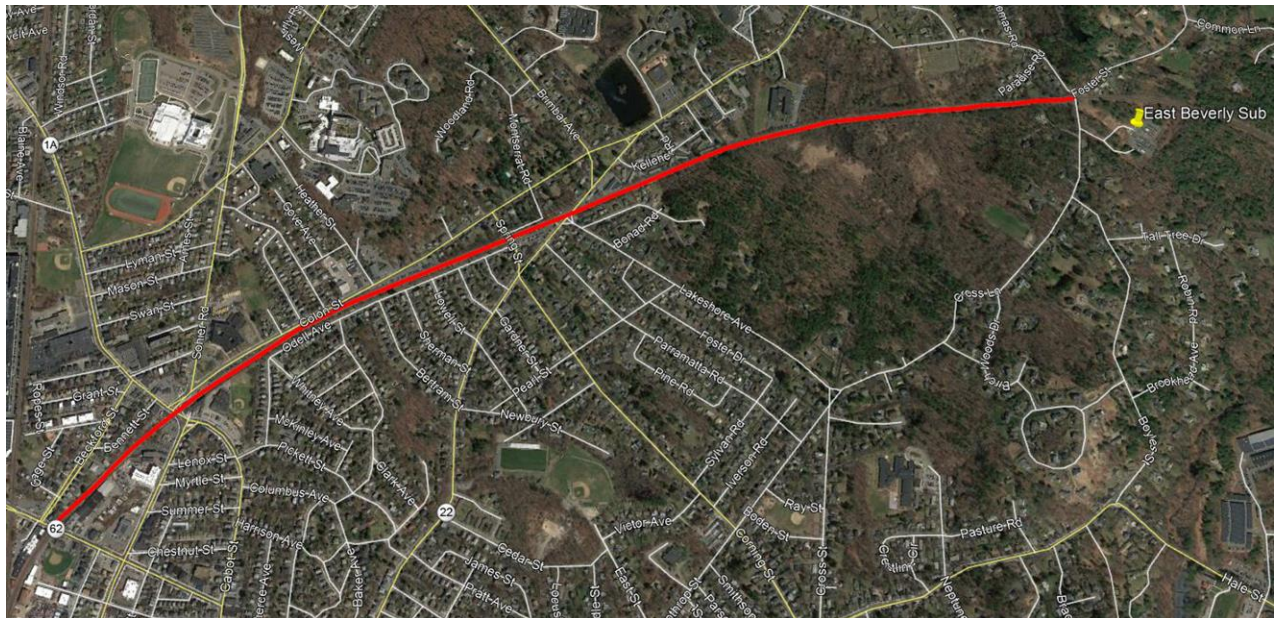
### **EXISTING ROW**

The main portion of the Newburyport/Rockport line extends 18.3 miles from Boston's North Station to the MBTA's Beverly Depot Station, located at 10 Park Street in Beverly, MA. The Rockport Branch begins at the Beverly Depot station and travels north and then northwest to the Montserrat, Prides Crossing and Beverly Farms stations in Beverly, the Manchester Station in Manchester-by-the-Sea, the West Gloucester and Gloucester stations in Gloucester, and the Rockport station in Rockport MA. The MBTA operates commuter trains on the Newburyport/Rockport line from xx a.m. to y.y. p.m.

The section of the Newburyport/Rockport ROW from NEP's Beverly #12 Substation to Elliot Street is approximately 3400 feet long and contains railroad bridges crossing over Pleasant Street and Federal Street. This section also includes the Beverly Depot station and multiple side tracks and switches where the Newburyport and Rockport lines split.



The Rockport Branch from the intersection of Elliot Street to the East Beverly Substation is approximately 9800 feet long and crosses three streets at grade, contains the Montserrat train station and abuts many residential backyards and a nature reserve. The route of the railroad ROW from Elliot Street to East Beverly Sub is shown in Figure 1.



**Figure 1 – Railroad ROW from Elliot Street to East Beverly Substation**

The railroad ROW currently contains two sets of tracks, the M-191 overhead transmission line, two direct buried 23kV circuits, the existing N-192 direct buried transmission cables, an overhead pole line supporting railroad communication lines, track switches and railroad signal equipment. In addition a vitrified clay pipe runs parallel to the tracks along a portion of the ROW and there are several culverts crossing under the tracks. A typical cross section of the railroad ROW showing its width and approximate location of the existing utilities is shown in Figure 2. Figure 3 is a plan view of the railroad ROW. Photographs of the railroad ROW at several locations are provided in Figures 4 – 6.

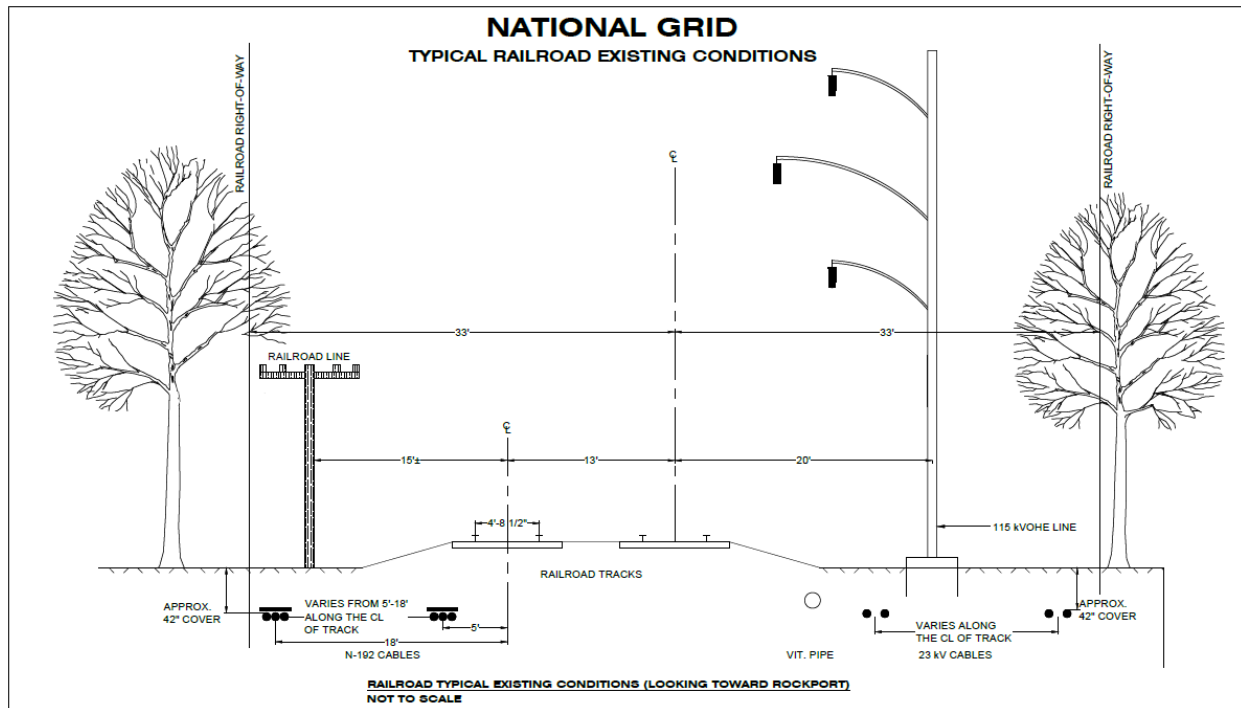


Figure 2 – Cross Section of Typical Railroad ROW with Existing Conditions

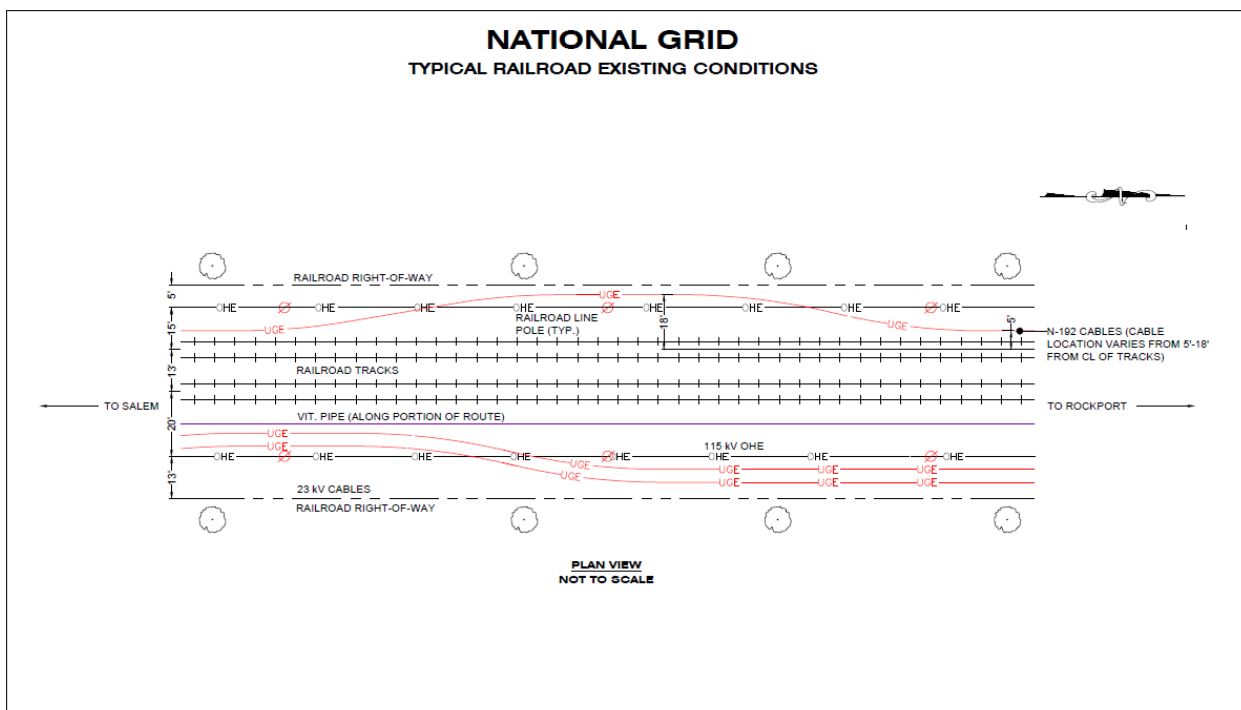


Figure 3 – Plan View of Typical Railroad ROW with Existing Conditions





**Figure 4 – Photograph of Railroad ROW at Spring Street Looking Toward Salem**  
(Note Track Signals, Control Houses and Dense Vegetation along Edge-of-ROW)



**Figure 5 – Photograph of Railroad ROW at Boyles St. Crossing Looking Toward Salem**  
(Note Rock Outcroppings on Both Sides of Tracks and Track Switching Equipment)





**Figure 6 – Photograph<sup>1</sup> of Railroad ROW at Essex St. Crossing Looking Towards Salem**  
(Note Montserrat Train Station Platforms on Both Sides of Tracks)

## **MBTA REQUIREMENTS**

Any installation on the MBTA railroad ROW must be completed in accordance with the rules and regulations contained in the MBTA's Railroad Operations Directorate (Directorate). Section IV of the Directorate mandates that facilities installed within an active rail ROW be placed outside the track live load influence zone. The line of track live load influence extends from a point 5.5 feet horizontally from the track base centerline on a slope of 2 horizontal to 1 vertical away from the tracks. The area inside the line of track live load influence is known as the zone of influence. Facilities installed within the zone of influence will be exposed to the heavy live loads from the trains and excavations within the zone of influence could disturb the rails unless special construction methods are used. Exceptions to the zone of influence exclusion are available, with the approval of the Director of Engineering for MBTA Railroad Operations, provided that at a minimum the facilities include increased structural reinforcement and steel sheeting and bracing is used for all excavation work including cable trenches and overhead tower foundations.

---

<sup>1</sup> Photo from Google Maps



To gain a better understanding of these requirements, National Grid met with representatives of the MBTA on August 10, 2018. The MBTA representatives confirmed that any new line construction would need to meet the requirements of the Directorate as summarized above, particularly with respect to the zone of influence.

In addition, the MBTA representatives noted that the MBTA is presently under a federal mandate to install a Positive Train Control (PTC) system along the entire length of the Newburyport/Rockport corridor. Construction of the PTC system will require the installation of various communications bungalows, cabinets, and equipment within the ROW and will impose additional clearance challenges to any new transmission lines. The MBTA representatives stated that the MBTA would not approve the installation of another utility line within the corridor until the PTC system is installed to avoid potential conflicts during installation, maintenance or operation of either system. Engineering of the PTC system is underway with installation likely not occurring until 2020.

#### **CONSTRUCTABILITY ASSESSMENT: UNDERGROUND TRANSMISSION LINE ON THE MBTA RAILROAD PROPERTY**

Installation of the new N-192 cable underground along the existing railroad ROW would require installing a duct bank and manhole system, pulling cable lengths into the ducts, and splicing the cable sections together inside the manholes. Manholes approximately 8' wide by 24' long would be required approximately every 1500 feet along the ROW. Installation of the new facilities requires a minimum work space width of 22 feet for an excavator and triaxle dump truck to pass each other along the construction zone. A larger area is required at locations where a manhole is installed and in areas where above grade utility lines and rail equipment may interfere with the duct bank construction.

As discussed above, the approximately 3400 foot section of Newburyport/Rockport ROW from NEP's Beverly #12 Substation to just south of Elliot Street contains railroad bridges crossing over Pleasant Street and Federal Street, Beverly Depot station and multiple side tracks and switches where the Newburyport and Rockport lines split. Due to these features there is not sufficient space within the railroad ROW to install the new transmission cables.

The Rockport Line north of the Newburyport/Rockport split is somewhat less congested, although it crosses three streets at grade, contains the Montserrat train station and abuts many residential backyards and a nature reserve. However, as discussed below, there is insufficient room to construct a new underground transmission cable within this section of the railroad ROW consistent with the Directorate.

The Directorate (Section IV) requires a minimum burial depth of 5 feet to the top of the conduits and mandates that the conduits be placed outside the zone of influence. This would require a minimum setback of approximately 19.5 feet from the nearest track centerline to the start of the



trench. The trench width for the new cable would be approximately 2.5 feet, placing the outside edge of the trench at least 22 feet from the centerline of the nearest track.

As can be seen in Figures 2 and 3, the edge of the ROW on the west side of the tracks is, on average, approximately 20 feet from the track centerline and approximately 33 feet on the east side. Based on these setback requirements, the duct bank and manholes could only be placed on the east side of the tracks near the edge of the ROW. However this area is already occupied by the two 23kV cables and the M-191 overhead transmission line. The presence of the 23 kV cables and the overhead line would restrict clearances for machinery, making it difficult to construct a duct bank and install the manholes. To meet these setback requirements, construction of a new underground line cannot be completed wholly within the railroad property. Easements from private property owners adjacent to the railroad ROW would be required to meet workspace requirements as illustrated in Figures 7 – 10 for multiple locations along the railroad ROW.



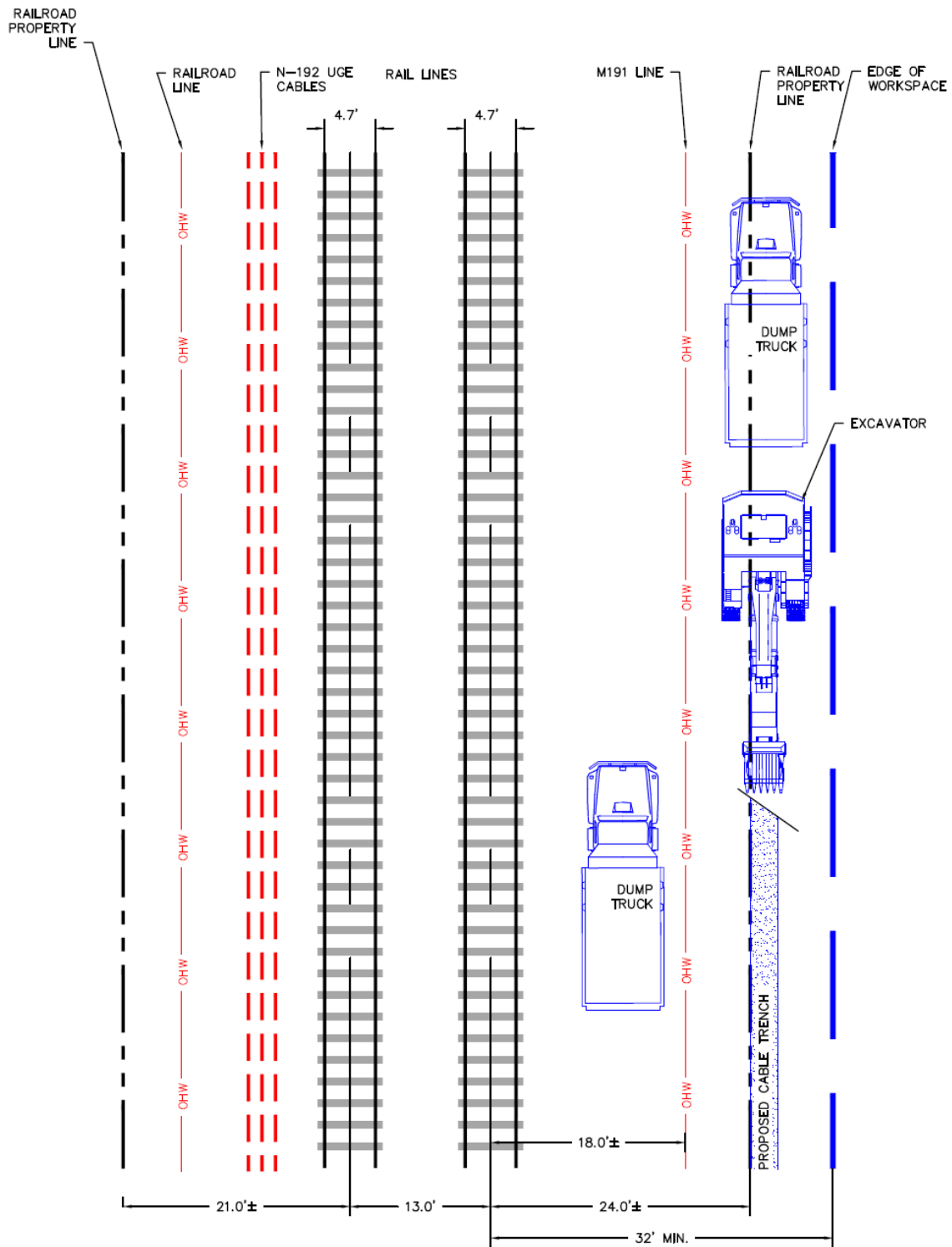


Figure 7 – RR Corridor Workspace Requirements Near Elliot Street

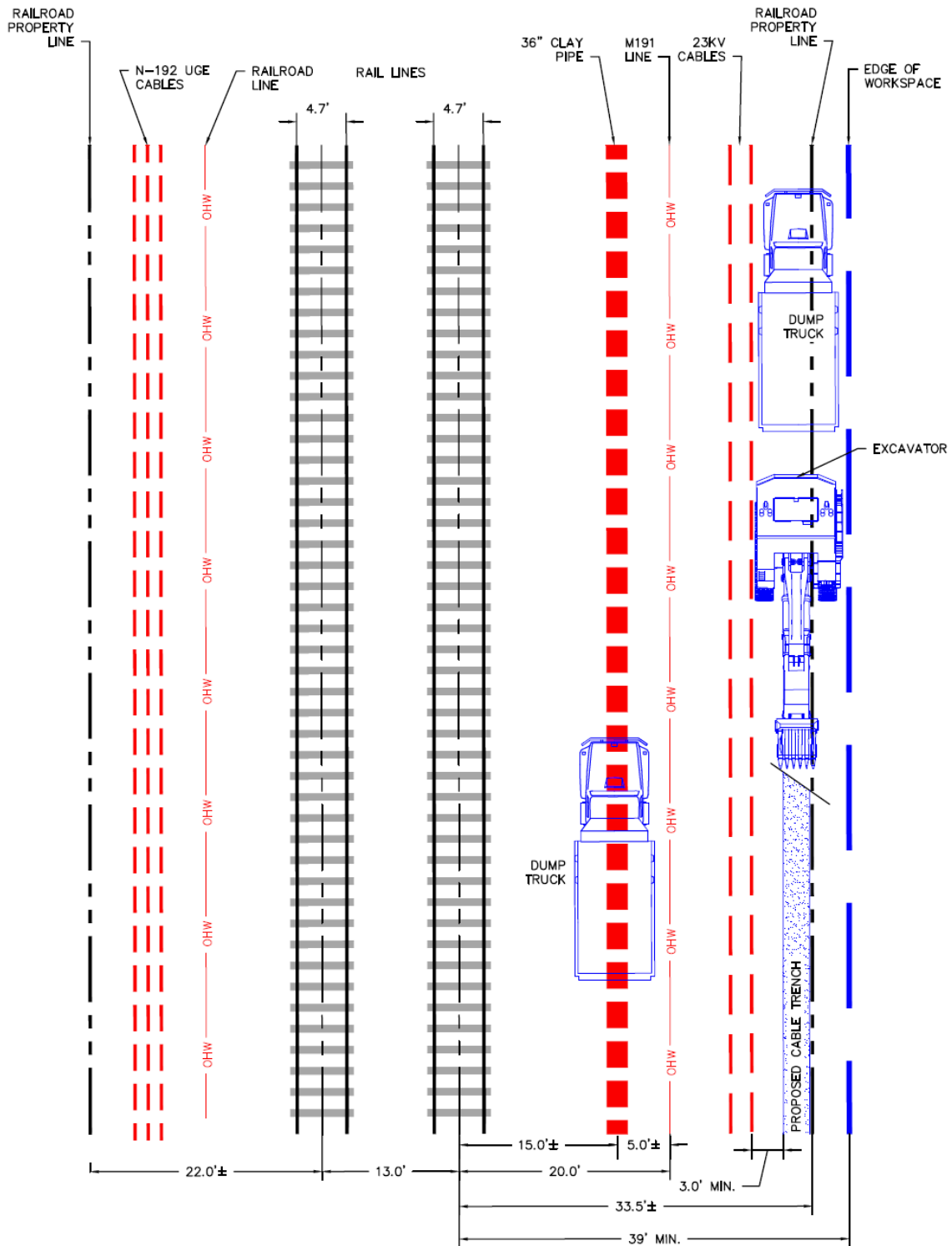


Figure 8 – RR Corridor Workspace Requirements Near Odell Ave. & Whitney Ave.

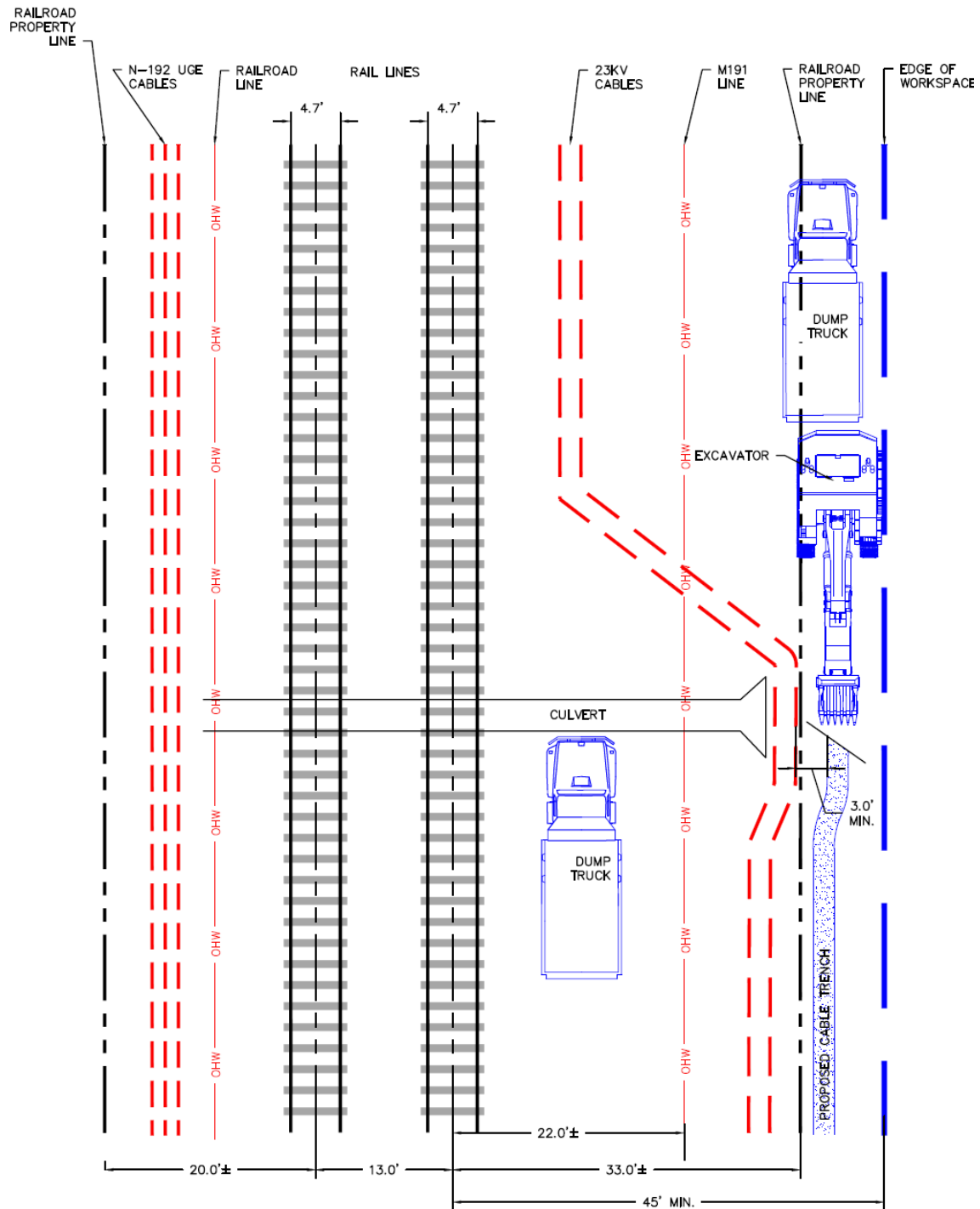


Figure 9 – RR Corridor Workspace Requirements near Culvert at M-191 Tower #42



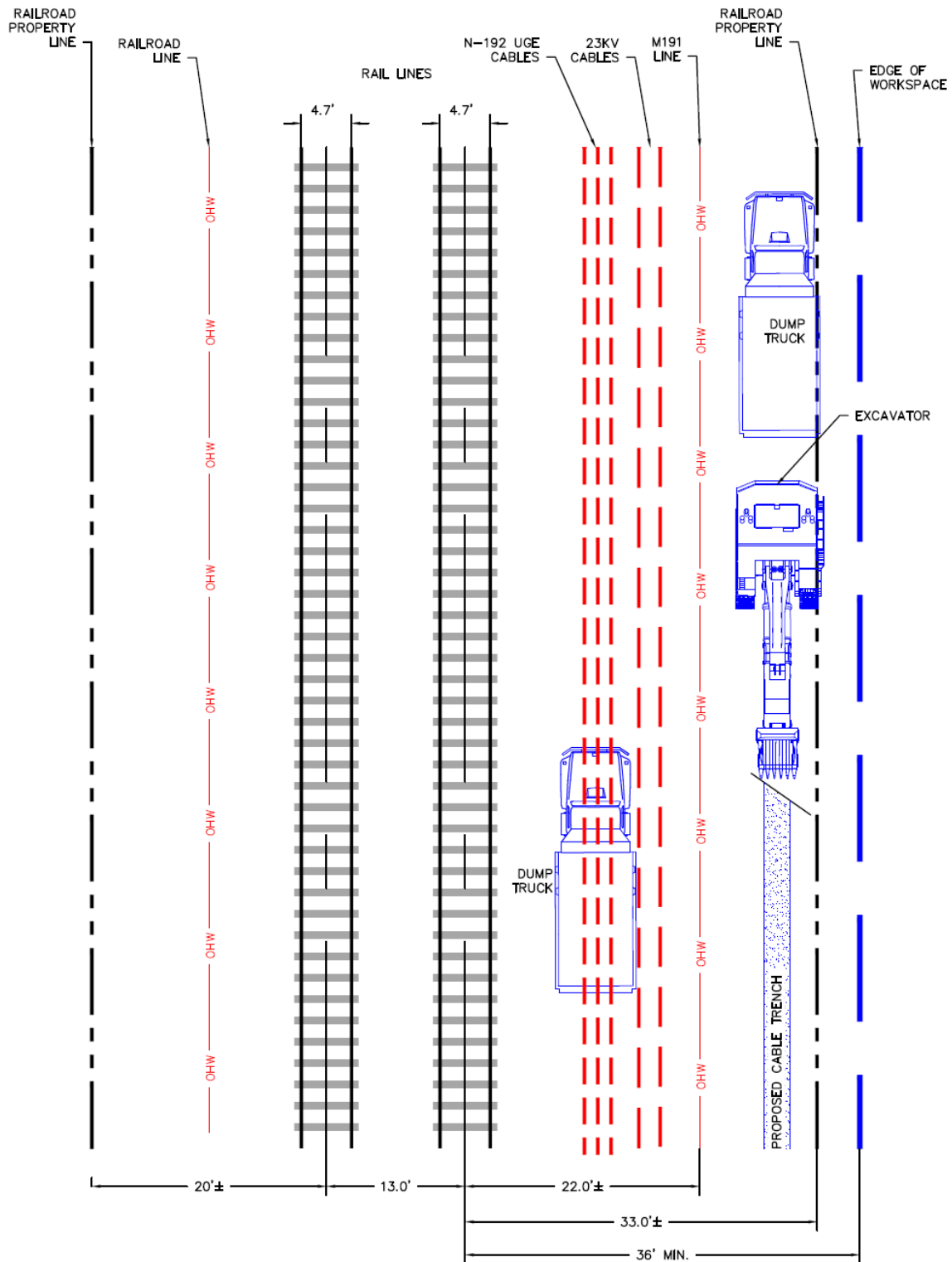


Figure 10 – RR Corridor Workspace Requirements Near Cole Street



The MBTA Directorate does provide an exception to the live load influence zone exclusion. With the approval of the Director of Engineering for MBTA Railroad Operations, the conduits could be installed within 22 feet of the track centerline, provided that interlocking steel sheeting is used along the entire trench and the duct bank is reinforced to withstand the very high railroad Cooper's E-80 loading with 50% added for impact. However, even with the steel sheeting and reinforcement, it is unlikely that the MBTA would approve the installation of the duct bank nearer the tracks since the presence of shallow bedrock along the ROW would require significant hammering or blasting to remove the rock. This could result in potential disruption of the track geometry. Moreover due to the presence of the energized overhead M-191 line, it would be difficult to maintain required clearances per National Electric Safety Code and National Grid standards during installation of steel sheeting.

Even if NEP could persuade the MBTA to provide a waiver from its live load influence zone rules, construction and installation of the transmission line within the railroad ROW still would have significant, potentially unmanageable community impacts for the following reasons:

- The MBTA would allow construction of the duct bank and manholes only while the trains are not operating, between the hours of 1:00am and 5:00am. This very narrow nighttime construction window would double the construction schedule and increase the costs for the work within the ROW by 50 – 100%. The nighttime work would be very disruptive to residential areas along the entire construction corridor, especially the noise associated with bedrock removal using drills and hoe rams.
- Additional construction easements would have to be secured from property owners along the length of the ROW to provide the required work space to install the duct bank and manholes.
- Removal and cutting of mature trees along the ROW edges and temporary construction easement areas along with the installation of a temporary construction access road would be required. This would affect existing visual and auditory barriers between the railroad tracks and existing homes.
- Six manholes would be needed along the railroad ROW. Each manhole requires an excavation approximately 12' wide and 28' long and work space around the excavation for tractor trailer delivery trucks and a crane to set the manhole sections.
- Permanent vehicle access would be needed to each manhole location for initial cable installation and future maintenance and repairs. This would require the acquisition of additional property rights as well as the construction of permanent access roads to each manhole location.



Considering the lack of available space along this section of the railroad ROW, the constraints imposed by the MBTA, and construction difficulties, installing an underground transmission line within the railroad corridor is not feasible.

## **OVERHEAD TRANSMISSION LINE ON THE MBTA RAILROAD PROPERTY**

National Grid engineers also assessed the feasibility of installing the new N-192 line as a second overhead transmission line within the existing railroad ROW, either as a second circuit on new common structures with the M-191 line (double circuit line), or as a separate line on a new set of single circuit structures. From a reliability standpoint, double circuit lines are less desirable.

Installation of a separate line would require installing new drilled shaft foundations and structures. There is insufficient space on the east side of the tracks to install a second line separate from the M-191 line and meet the required clearances. Installation of a separate line on the west side of the tracks, double circuited with the railroad line, was reviewed however installing new drilled shaft foundations between the existing N-192 underground cables and the edge of the right of way while maintaining clearances would not be possible.

Adding a second circuit on common structures with the M-191 line (double circuit line) would require replacing the existing concrete foundations and structures to accommodate the second set of conductors. Lengthy outages of the M-191 line would be required to replace the foundations and structures to accommodate the addition of a second circuit on the existing M-191 structures.

Similar to the installation of an underground line, there are a number of concerns and obstacles associated with constructing an overhead line within the railroad ROW including restrictive work hours; difficulty accessing the lines for installation, maintenance and repairs; removal of mature trees; noise during construction; and the lack of workspace within ROW. In addition, maintaining required clearances to the edge of the ROW per the National Electric Safety Code, MBTA Directorate and National Grid standards do not appear possible for an additional overhead line within the existing railroad ROW. For these reasons, installing an overhead line within the railroad ROW is not feasible.

## **OPERATIONAL ISSUES**

Although not within the scope of this constructability review, ECE notes that siting a transmission line along an active railroad corridor creates potential conflicts between the operational needs of the railroad operator and the transmission system operator. Under the anticipated terms of any license or easement, the operation of the railroad remains paramount over the operation of the transmission facility. Arranging for access to an active railroad ROW for routine maintenance or emergency repairs involves notifying the railroad company, arranging





for flagmen, and working within the schedule constraints required by the railroad. This can be burdensome where access for routine maintenance is needed, and critically important where emergency access is required and time is of the essence. In National Grid's experience, the need to obtain flagmen has delayed emergency repairs along other railroad ROWs for several hours, and has delayed routine maintenance work for weeks.

Finally, in recent years the MBTA has been unwilling to issue permanent licenses or easements for utility installations along its ROWs, active or inactive. Thus, the MBTA could require National Grid to relocate its facilities at National Grid's expense at any time.

## **CONCLUSION**

Considering the difficulties and cost of constructing on the railroad ROW, lack of available space within the MBTA property, need for private property easements, MBTA's rejection of allowing new utilities within the railroad property until after the PTC system is fully implemented during the August 10 meeting, ECE and National Grid conclude that neither the installation of a new underground nor an overhead transmission line along the MBTA tracks is feasible.